

25 24. (new) The method of Claim 21, wherein said steps a), b) and c) are performed on two surfaces of said film.

REMARKS

Reconsideration of the above-referenced application in view of the following remarks is respectfully requested.

The abstract was objected to because of an informality relating to reference numerals. The abstract has been amended in response to the objection. The drawings were objected to as not showing a claimed element. A proposed change to Figure 7 is included herewith in response to the objection.

Claims 10-20 were pending in this case. Claims 10-15, 17, 19 and 20 had been withdrawn from consideration and are now cancelled. Claims 16 and 18 have been amended. New Claims 21-24 have been added.

Claim 18 stands rejected under 35 U.S.C. 112, first paragraph. Applicant respectfully traverses the rejection. It is asserted in the Office Action that the specification fails to provide support for "removing the embossing tool having raised areas coated with a thin layer of metal comprising a pattern of conductors and vias." Applicant is unclear as to where in Claim 18 the Examiner is quoting from, since the claim language relating to the removal of the embossing tool is simply "removing the embossing tool" in the first instance (i.e. step c) and "physically removing the embossing tool" in the second instance (i.e. step e). Support for these steps is found in the specification on page 16 in the second paragraph, which includes the following passage

“Securing a metal matrix with embossed studs and/or conductor patterns fabricated from known technology such as electroforming or etching, coating the raised areas with a loosely held thin film of copper, transferring the copper film to a dielectric film using heat and pressure, physically removing the matrix, and subsequently plating the appropriate thickness of copper over the thin film of copper. [emphasis added]”

The claimed “embossing tool” is the metal matrix in the embodiment of the invention being described in the quoted passage. Therefore, Applicant respectfully submits that the specification contains support for the claimed step.

Claims 16 and 18 stand rejected under 35 U.S.C. 112, second paragraph. Claim 16 has been amended such that it is in statutory form. Applicant respectfully traverses the rejection of Claim 18. The Examiner asserts that the step of “removing the embossing tool” renders the claim vague and indefinite. The Examiner states that it is unclear whether the entire embossing tool is removed or not. Applicant respectfully disagrees. The claim says the embossing tool is removed, it does not say that only a part of the embossing tool is removed nor does it give any impression other than that the entire tool is removed. With regard to step a), the Examiner has pointed to an alleged contradiction between the claimed invention and Figs. 4c-4d. Applicant respectfully points out that Claim 18 is addressed to the embodiments discussed with respect to Figures 7 and 8 (see pages 16 and 17 of the specification). It is Claim 16 that is addressed to the embodiment shown in Figure 4, not Claim 18.

Claim 16 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaoka, et al. (U.S. Patent No. 6,010,769) in view of Sumi, et al. (U.S. Patent No. 5,979,044). Claim 16 includes the feature of “providing a metal matrix embossing tool comprising a copper film having a plurality of transverse copper studs integral therewith; placing said tool studs in contact with said second surface.” Sasaoka does not teach or suggest studs integral with a copper film.

In contrast, Sasaoka forms pillars 24 of conductive paste or resin (see, e.g., column 23, lines 47-59). As noted by the Examiner, Sasaoka also fails to teach or suggest the step of "electroplating a thin film of copper onto both sides of the copper coated polymer film." The Examiner cites Sumi to cure this deficiency of Sasaoka. Applicant respectfully submits that such a combination would not be obvious to one skilled in the art since Sasaoka's pillars are formed of conductive resin, not copper, and Sumi teaches plating only on copper. This is in contrast to Applicant's claimed invention in which a copper stud is mated to a copper sheet and then coated with electroplated copper. Therefore, Applicant respectfully submits that Claim 16 is patentable over Sasaoka in view of Sumi.

Neither Sasaoka nor Sumi teach or suggest the features of Claims 18 or 21-24. Therefore, Applicant respectfully requests consideration and allowance of those claims.

In view of the above, Applicant respectfully requests the entry of this amendment, the withdrawal of the Examiner's rejections, and allowance of Claims 16, 18, and 21-24. If the Examiner has any questions or other correspondence regarding this application, Applicant requests that the Examiner contact Applicant's attorney at the below listed telephone number and address.

Respectfully submitted,



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Version with Markings to Show Changes Made

Abstract

A method for the fabrication of a double-sided [double-side] electrical interconnection flexible circuit (200) particularly useful as a substrate for an area array integrated circuit package. A copper matrix with studs (203) is pressed through a dielectric film (201) having a copper layer on the opposite surface, thereby forming an intermediate structure for a flex circuit with self-aligned solid copper vias in a one step process. The contacts are reinforced by plating both surfaces with a layer of copper, and conventional processes are used to complete the circuit patterning.

Claims

16. (twice amended) A method of manufacturing an intermediate base structure for a flex circuit including the steps of:

a) providing a flexible base polymer film having first and second surfaces and a layer of copper on the first surface;

b) providing a metal matrix embossing tool comprising a copper film having a plurality of transverse copper studs integral therewith; placing said tool studs in contact with said second surface;

c) applying a force to said metal matrix embossing tool so that the studs of the tool punch through the copper coated polymer film, thereby creating a plurality of vias filled with the studs, and attaching the film matrix to the second surface [side] of the polymer [flex] film;

d) electroplating a thin film of copper onto both sides of the copper coated polymer [clad flex] film.

18. (twice amended) A method of manufacturing a flex circuit on a flexible base polymer film including the steps of:

- a) superimposing on said film an embossing tool having raised areas comprising a pattern of conductors and vias corresponding to a circuit design, wherein, said raised areas are coated with a thin layer of metal, comprising copper,
- b) applying heat and pressure to simultaneously emboss the film and to transfer said thin metal layer from the embossing tool to the polymer film,
- c) removing the embossing tool,
- d) embossing a pattern corresponding to that of the second surface of a flex circuit, and simultaneously transferring a thin layer of metal into the embossed pattern,
- e) physically removing the embossing tool,
- f) plating a layer of copper to fill the vias and conductor patterns on both sides of the film,
- g) plating a layer of nickel and gold onto the exposed copper patterns, and
- h) applying a solder mask on the surface of the film surrounding the solder ball contact pads.

21. (new) A method of manufacturing a flex circuit on a flexible base polymer film including the steps of:

- a) positioning adjacent to said film an embossing tool having raised areas comprising a pattern of conductors and vias corresponding to a circuit design, wherein said raised areas are coated with a thin layer of metal;
- b) applying heat and pressure on said tool to simultaneously emboss the film and to transfer said thin metal layer from the embossing tool to the polymer film; and
- c) plating a second layer of metal on said transferred thin metal layer.

22. (new) The method of Claim 21, wherein said thin layer of metal is copper.

23. (new) The method of Claim 21, wherein said second layer of metal is copper.

24. (new) The method of Claim 21, comprising the step of plating at least one additional layer on said second layer of metal.

24. (new) The method of Claim 21, wherein said steps a), b) and c) are performed on two surfaces of said film.